pauperism; education; illiteracy; prices of commodities; and prices of wheat. Students who may wish to know the recent history of London with regard to any one of these subjects will at once find what they want by turning to the diagram or diagrams referring to the matter. Opposite each diagram are short notes indicating clearly and concisely what the curves appear to teach, and directing the reader to the original sources from which the facts are taken. It is impossible to turn over these pages without feeling, as the author does, that if some improvement of the social condition of London is discernible it is, after all, but meagre. Probably, too, most people who make themselves familiar with the results he has so carefully classified, and rendered so easily intelligible, will agree with him that in dealing with the social problem we as a people are apt to think too much about cure, and too little about prevention. "Year by year," says Mr. Macdowall in his interesting preface, "we reap, somewhat sadly, our weedy crop; but we leave the weed-roots in the ground. To use another figure, we contend in a vigorous way with the waters of a domestic deluge, but omit to turn off the tap from which they come."

A System for the Construction of Crystal Models. By John Gorham, M.R C.S.Eng., &c. (London and New York: E. and F. N. Spon, 1888.)

THE author of this book expounds an ingenious method of making models in paper by plaiting together three or four strips cut into the form of a succession of the crystal faces. The book consists mainly of figures, which show how these plaits are to be drawn, and the order in which they are to be interwoven for some of the primitive forms in the different systems.

It does not appear that the models are more easily or neatly made by this than by the more familiar methods, but they have one real advantage in their portability, since they may at any time be unfolded into a flat sheet. The method would, however, be somewhat awkward when applied to complicated combinations.

Some of the simple forms are omitted in the descriptions, *e.g.* the icositetrahedron, pentagonal dodecahedron, &c., and it is hardly necessary to remark that the four-faced cube is not a form assumed by some varieties of quartz (p. 8). We hesitate to believe the author serious in his suggestion that a natural cube may actually grow by plaiting itself from three zones of molecular laminæ, "each endowed with a force compelling it to bend at a right angle at given intervals."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Functionless Organs.

I HAVE only just seen NATURE for August 16 and 23 (pp. 364 and 387). In both these there are letters which attribute to me personally the assertion that the electric organs in "the skate" are functionless, and are "on the way to use"—not aborted or degenerated from former use. I made no such assertion. My letter on the subject referred to a verdict given on this question in respect to one particular species (*Raia radiata*) by Prof. Ewart in NATURE of July 26 (p. 310). I refer Prof. Ray Lankester to the paper of Prof. Ewart, communicated to the Royal Society through Prof. J. Burdon-Sanderson. As the result of an elaborate argument, founded on anatomical details, the author concludes that the "cups of *Raia radiata* are in process of being elaborated into more complex structures"; and again, "that the electric organ of *Raia radiata*, notwithstanding its apparent uselessness and its extremely small size, is in a state of progressive development."

This is not my conclusion, but the conclusion of an expert, who gives his reasons, and differs from Prof. Ray Lankester in having, apparently, no preconceived theory to support.

If the doctrine of evolution be true—that is to say, if all organic creatures have been developed by ordinary generation from parents—then it follows of necessity that the primæval germs must have contained potentially the whole succeeding series. Moreover, if that series has been developed gradually and very slowly, it follows also, as a matter of necessity, that every modification of structure must have been functionless at first, when it began to appear. On this theory it seems to me to be not a matter of argument, but a matter of certainty, that all organic nature must have been full of structures "on the rise," as well as of others on the decline.

Why is this not recognized? Because organs "on the rise" cannot be due to utility as a physical cause, but must be due to utility as an end yet to be attained. This is what I mean by a "prophetic germ." We now know that Darwin resisted and rejected this idea, at least at one time of his life, as fatal to his own theory of natural selection. And so it is, if natural selection is made to account for structures before they are presented for selection to act upon. But this is obviously nonsense. Things cannot be selected until they have been first produced. Nor can any structure be "selected by utility in the struggle for existence" until it has not only been produced, but has been so far perfected as to be actually used.

If Prof. Ray Lankester will explain how "natural selection" can act upon "congenital variations" which he calls "non-significant"—*i.e.* which are not yet of any actual use—and if he will explain how this action can afford "the single and sufficient theory of the origin" of (as yet) useless variations, he will have accomplished a great triumph in logic and philosophy.

Meantime, I adhere to that view of all organs which is indelibly impressed on our very forms of speech, and is notably expressed in Prof. Burdon-Sanderson's letter in NATURE of August 23. He speaks of electric organs as "an apparatus for producing electric discharges." This is exactly correct. They are "apparatuses" for a special purpose or function; and like all other apparatuses, they have to be prepared through embryotic stages in which they are not capable of use. I have been long looking for some actual case in which experts should recognize an organ "on the rise." Prof. Ewart's is the first I have seen. I am not responsible for his facts, or for his reasoning. But the mere fact of such a view being taken by an eminent man in a responsible position is a circumstance highly significant.

The recognition of even one case will be the recognition of a new idea—new, at least, in its application, and new in its wide significance of interpretation. It will be the counterpart in actual observation of that strategic movement in abstract reasoning which has recently led Mr. Herbert Spencer to expose the fallacies involved in the phrase "natural selection," and in his own neater and adroiter form of it, "survival of the fittest."

ARGYLL.

I HAVE read with much interest the report in NATURE of July 26 (p. 310) of Prof. Ewart's very remarkable paper on the electric organ of the skate, and the Duke of Argyll's letter on the same subject in NATURE of August 9 (p. 341). The Duke is manifestly right, that a single proved instance, such as Prof. Ewart here endeavours to make out, of an organ which has been evolved, or is in process of evolution, while not in a state of functional activity, would be sufficient to disprove Darwinism as a complete theory; for if all perfectionment is due to the two causes of exercise through habit and natural selection among variations, it is obvious that no improvement can be effected which is not immediately useful.

I believe that the animal kingdom, and in all probability the vegetable kingdom also, are full of organs which cannot have been evolved by anything like a Darwinian process, because their immature states cannot have been in functional activity. In my work on "Habit and Intelligence" (2nd edition, Macmillan, 1879), chapters xvii., xviii., and xix., I have enumerated some of these. The strongest part of the argument is, I think, that derived from the brain of man. It has been pointed out by Wallace, the naturalist who was near anticipating Darwin in the theory of natural selection as applied to the rest of the organic creation, that the brain of savage man has attained a development which is out of all proportion larger than can correspond to the mental development which is united with it—in other words, the brain of savage man is nearly equal to that of civilized man,

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while his mental development is very far inferior;—so that, as Wallace remarks, "the idea is suggested of a surplusage of power; of an instrument beyond the wants of its possessor." And if it is true, as I believe it is, that the brain of savage man finds its special activity in the formation and use of language, this does not solve but only transforms the difficulty; for language itself must in prehistoric times have attained a development far in advance of the intellectual wants of those who formed it, because the same languages, with comparatively few additions to the vocabulary and no further grammatical development, still suffice for the wants of their civilized descendants; whereas, on Darwinian principles, language could not be evolved beyond the intellectual needs of those speaking it.

There are also many cases in the lower creation where structure appears to have been developed, not as the result of function but in anticipation of function; just as a ship is built on the land for the purpose of afterwards floating on the water. I cannot occupy your space with details of these, but will enumerate those of which the evidence seems tolerably distinct.

All the Hydrozoa are probably descended from a form resembling the Hydra, between which and the Medusæ there is a gradation, though not quite unbroken. Once the Medusa is produced and swims away from the plant-like stem that bore it, its powers of wandering, and dispersing its eggs widely, will give its species a great advantage in the struggle for existence. But how can any natural selection effect the evolution of the Medusa while it is still imperfect, and sheds its eggs without leaving the parent stem?

Müller, in his "Facts for Darwin," says of the transition from the Zoea to the Mysis form in the metamorphoses of a species of Peneus, or prawn, that "the long abdomen, which just before was laboriously dragged along as a useless burden, now, with its powerful muscles, jerks the animal through the water in a series of lively jumps." The Nauplius, which is the form in which this Peneus leaves the egg, has no abdomen; this is acquired when the Nauplius develops into a Zoea, and consists of segments which appear between the body and the tail of the Nauplius. Müller's account seems to show that this abdomen is developed before it is useful to the animal, and for the purpose of becoming useful further on in its development. It is to be observed that in this case, as in that of the Medusa, the entire evolution goes on amid the same surroundings: unlike the case of Batrachia and most insects, there is no change of the conditions of life to accompany the transformation and to help to account for it. The same remark applies to the development of the star-fish out of the Bipinnaria, and of the sea-urchin out of the Pluteus—two of the most wonderful metamorphoses known.

The development of the lungs of the Batrachian out of the swim-bladder of the fish is an adaptive modification, and presents no special difficulty. But in the cellular and spongy texture of the swim-bladder of many Ganoid fishes, there appears to be a preparation for future transformation into lungs. This, however, is a point on which it would not be right to lay much stress. But it is different with the development of the fin of the fish into the leg of the Batrachian. The intermediate state appears to be preserved in the fin-rays—we can scarcely call them fins—of Lepidosiren. The single fin-ray of Ceratodus has in Lepidosiren lost its membrane, and consequently become inefficient as a fin, without being in any degree efficient as a leg, or acquiring any vestige of a foot; such a change cannot be beneficial to an animal which is still a fish and lives a fish's life; it can be interpreted, so far as I see, only as a preparation for the ultimate development of feet and legs. This development, however, does not appear to have been actually attained by any descendant of Lepidosiren; for its scaly covering, and the peculiarity of its nostrils, go far to forbid the supposition that the Batrachia can be its descendants.

Another instance of the same kind is that of those Ascidian larvæ which are the probable origin of the Vertebrata. Of what use can the dorsal groove and the notochord be to those minute and lowly organized animals themselves? They appear capable of interpretation only as the preparation for a vertebral column and a spinal cord to be afterwards evolved. But the strongest instance of the kind which I know of, except that of the brain of man, is the existence of pneumatic bones (that is to say, bones hollowed out for lightness, like those of flying birds) among Dinosaurians (see Prof. Cope's paper on *Megadactylus probyzelus* as reported in NATURE, vol. i. p. 347). The resemblances of the skeleton appear to prove that birds must be descended from Dinosaurians. No Dinosaurian had the power of flight, yet here is a character useful only to flying animals, and interpretable only as a preparation for a power of flight to be afterwards evolved.

Were a competent anatomist and morphologist to search for them, the entire organic world would probably be found to be full of such instances of what I call structure in anticipation of function.

JOSEPH JOHN MURPHY.

Belfast, August 22.

IT is evident from the letter of the Duke of Argyll under this heading in your issue of August 9 (p. 341), that he has altogether misconstrued some of the main biological principles which Darwin promulgated; and it also appears as if the entire neglect of certain important items which received due consideration in the "Origin of Species" is either done with purpose, or else is simply an effect of obscuration. In either case, the fallacious interpretation may be due to the polemical style in which his Grace is usually wont to distinguish himself, and the strong bias imported into the treatment has rendered a true representation of the conclusions he assails altogether impossible.

Exception must be taken to the very setting forth of the premises of the Duke's argument. "Sometimes," he says, the organs "are *called* 'aborted,' sometimes 'degenerated,'" &c. This certainly is so for no less a reason than that sometimes they *are* aborted, while at other times they are "representative," or sometimes, again, they are incipient organs. So variously, indeed, are the organs affected, that Darwin found it in some cases extremely difficult to pronounce respecting them.[1] The uninitiated in the subject would naturally infer, from the letter in question, that Darwin had never devoted any of his pages to the discussion of those organs which he generally spoke of as "nascent"—a term which the Duke, for the purposes of his argument, ignores. There is, moreover, nothing in any way new suggested by him in his communication.

The special case referred to, for instance, is simply one of the difficult problems which Darwin set himself, in the "Origin of Species," to solve, and respecting which he concluded, from his knowledge of all the facts then available, that "as we know nothing about the habits and structure of the progenitors of the existing electric fishes [of the various non-related types dealt with], it would be extremely bold to maintain that no serviceable transitions are possible by which these organs might have been gradually developed" ("Origin," sixth edition, p. 150). Whilst in the "Descent" a long section is devoted to the citation of instances of homologous rudimentary structures in man, and functionless organs generally are amply treated upon elsewhere—compare the various references in "Variation," and also "Origin" (pp. 108–12). In some instances they are determined to be vestigial, though for the most part they can only be so recognized in their ancestral relation.

Although Prof. Ray Lankester, in his interesting chapter on "Degeneration" ("Nature Series"), aptly remarked, "We have as possibilities either *balance*, or *elaboration*, or *degeneration*," I am inclined to think—in agreement, probably, with the Duke—that in that paper perhaps too much weight was attached to the last-named process. Perhaps it was due to the expressed desire of calling attention to Dr. Dohrn's treatise on the subject; but, after all, it is simply a view that is taken respecting certain important facts, and whether an organ in a transitional state is progressing or retrogressing is a matter which relates chiefly to time, and does not invalidate the fact of the change that is in process of evolution. It has not, however, been satisfactorily proved, so far as I can find, that the limited digitation in *Bipes* and *Seps* is the result of atrophy, as decidedly stated by Prof. Lankester; but as I am uninformed respecting the ontogeny—upon which everything depends—of these reptilian forms, I may be wrong in questioning this point.

Instances of transitional and incipient organs, rare though they may be, *have*, therefore, been fully considered by Darwin in his volumes; but we may, speaking more generally, truly say that the entire development hypothesis is a recognition of the structural deformation of nascent organs, which are ever being reconstituted, mainly in a progressive direction. The difficulty of actually observing an organ in process of development was acknowledged by Darwin to be considerable, partly on account of the slow rate of progression, and partly because

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[1] "It is often difficult to distinguish between rudimentary and nascent organs; for we can judge only by analogy whether a part is capable of further development, in which case alone it deserves to be called nascent" "Origin," sixth edition, p. 398).

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